MODELING AND SIMULATION DOMAIN ANNEX

> *The Defense Modeling and Simulation Office (DMSO) manages this annex.*

M&S.1   DOMAIN OVERVIEW

M&S.1.1   PURPOSE

The Modeling and Simulation (M&S) Domain Annex identifies additions to the JTA core elements (standards, interfaces, and service areas) listed in Section 2 of the JTA. These additional standards are key to the interoperability of M&S within DoD among themselves and real-world systems.

M&S.1.2   BACKGROUND

In 1992 DoD established a vision for modeling and simulation, as stated in the DoD M&S Master Plan. "Defense modeling and simulation will provide readily available, operationally valid environments for use by the DoD Components:

— To train jointly, develop doctrine and tactics, formulate operational plans, and assess warfighting situations.

— To support technology assessment, system upgrade, prototype and full-scale development, and force structuring.

Common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture." (Executive Council for Modeling & Simulation).

Department of Defense Directive 5000.59, DoD Modeling and Simulation (M&S) Management, January 4, 1994, and DoD 5000.59-P, DoD Modeling and Simulation (M&S) Master Plan (MSMP), October 1995, outline DoD policies, organizational responsibilities and management procedures for M&S and provide a comprehensive strategic plan to achieve DoD's vision of readily available, authoritative, interoperable and reusable simulations.

Objective 1 of the DoD MSMP states "Provide a common technical framework for M&S" and includes, under sub-objective 1-1, the establishment of "a common high level simulation architecture to facilitate the interoperability of all types of simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components." The efficient and effective use of models and simulations across the Department of Defense and supporting industries requires a common technical framework for M&S to facilitate interoperability and reuse. This common technical framework consists of: (1) a high level architecture (HLA) to which simulations must conform; (2) conceptual models of the mission space (CMMS) to provide a basis for the development of consistent and authoritative M&S representation; (3) data standards to support common understanding of data across models, simulations, and real world systems.

The HLA is a progression from the previous architectures and associated standards which have been developed and used successfully for specific classes of simulation. These include Distributed Interactive Simulation (DIS) protocol standards which support networked, real-time, platform-level virtual simulation and the Aggregate Level Simulation Protocol (ALSP) which is used to support distributed, logical-time, constructive simulations. The HLA provides a common architecture for all classes of simulation and, consequently, the HLA supersedes both the DIS and ALSP standards. Transition of simulations from use of other standards is underway in accordance with DoD M&S policy.

M&S.1.3 DOMAIN DESCRIPTION

This annex provides a set of standards affecting the definition, design, development, execution and testing of models and simulations. DoD modeling and simulation ranges from high-fidelity engineering simulations to highly aggregated, campaign-level simulations involving joint forces. Increasingly the Department and supporting industries are integrating and operating a mix of computer simulations, actual warfighting systems, weapons simulators and instrumented ranges to support a diversity of applications including training, mission rehearsal, operational course of action analysis, investment analysis, and many aspects of acquisition support throughout all phases of the system lifecycle. Figure M&S-1 shows the position of the M&S domain in the Notional JTA Hierarchy.
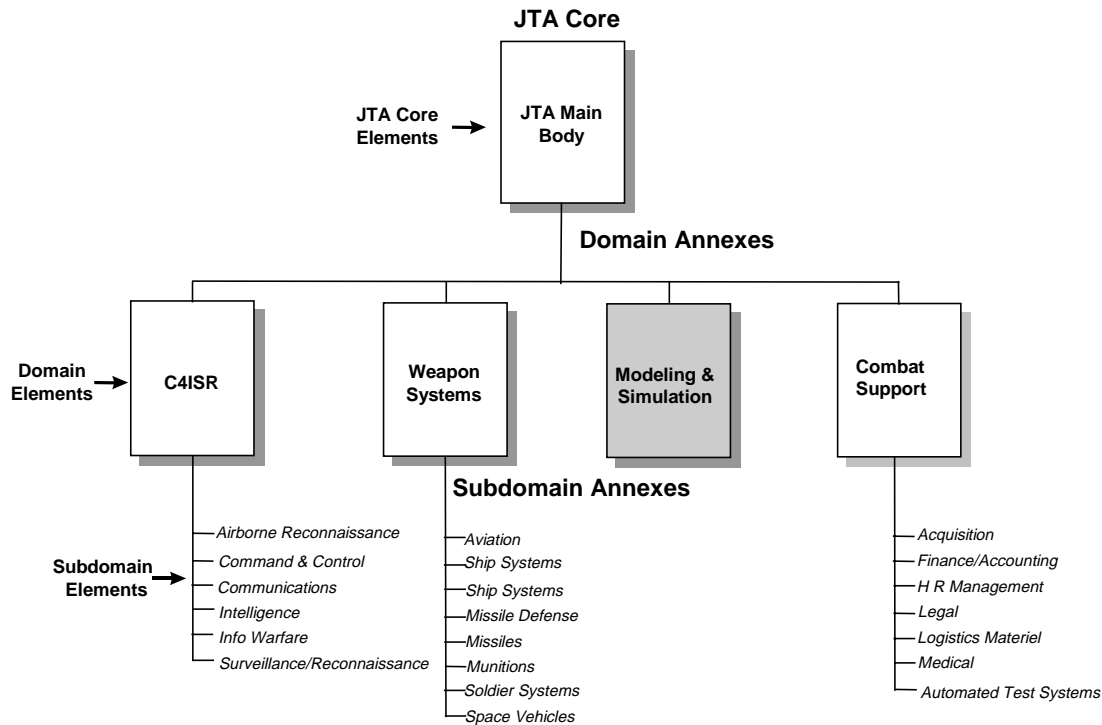
JTA Core

JTA Main Body

JTA Core Elements →

Domain Annexes

Domain Elements →

C4ISR

Weapon Systems

Modeling & Simulation

Combat Support

Subdomain Annexes

Subdomain Elements →

Airborne Reconnaissance
Command & Control
Communications
Intelligence
Info Warfare
Surveillance/Reconnaissance

Aviation
Ship Systems
Ship Systems
Missile Defense
Missiles
Munitions
Soldier Systems
Space Vehicles

Acquisition
Finance/Accounting
H R Management
Legal
Logistics Materiel
Medical
Automated Test Systems

Figure M&S-1 Notional JTA Hierarchy

M&S.1.4   SCOPE AND APPLICABILITY

The Under Secretary of Defense for Acquisition and Technology (USD(A&T)) in 1996 designated the HLA as the standard technical architecture for all DoD simulations. The HLA is a technical architecture that applies to all classes of simulations, including virtual simulations, constructive simulations, and interfaces to live systems. The virtual simulation class comprises human-in-the-loop simulators. The constructive simulation class includes wargames and other automated simulations which represent actions of people and systems in the simulation. The live simulation class includes C4I systems, weapon systems/platforms, and instrumented ranges.

The High Level Architecture and related M&S standards listed here address those key technical aspects of simulation design necessary to foster interoperability and reuse, but avoid overly constraining implementation details. They are intended for use in simulations addressing a full range of training, analysis, and acquisition requirements, each of which may have different objectives that dictate different representational details, timing constraints, processing demands, etc. The M&S technical standards in this annex provide the framework within which specific systems, targeted against precise requirements, can be developed. While many of these systems will operate in computational environments that are considered standard and fall within the spectrum of the other JTA standards, some may require massively-parallel processing or other unique, laboratory configurations, bringing with them their own set of requirements. Simulation developers should follow those standards required for the environment in which the simulation is implemented.

Mandates listed in this domain annex are in addition to those listed in Section 2 of the JTA core.

M&S.1.5   TECHNICAL REFERENCE MODEL

There is no separate Technical Reference Model established for the M&S Domain.

M&S.1.6　　　　ANNEX ORGANIZATION

The Modeling and Simulation Domain Annex consists of three sections. Section M&S.1 contains the overview, Section M&S.2 contains those Information Technology standards that are additions to the standards contained in the core, and Section M&S.3 is reserved for those mandates for modeling and simulation that are domain specific because they do not map directly to the core service areas.

M&S.2　　　　ADDITIONS TO THE JTA CORE

M&S.2.1　　　　INTRODUCTION

The following standards apply in addition to those found in the core of the JTA. On September 10, 1996 the Under Secretary of Defense for Acquisition and Technology (USD(A&T)) designated the High Level Architecture (HLA) as the standard technical architecture for all DoD simulations. The HLA, as mandated, is defined by the HLA Rules, the HLA Interface Specification and the HLA Object Model Template Specification. Compliance criteria have been set forth in the compliance checklist, which was developed as part of the HLA, along with the HLA test procedures. These form the technical basis for HLA compliance. The following additional standards are mandated, current versions of which are listed and available at the Defense Modeling and Simulation Office World Wide Web site at:

http://www.dmso.mil

M&S.2.2　　　　INFORMATION PROCESSING STANDARDS

M&S.2.2.1　　　　Introduction

In addition to those mandates for Information Processing Standards described in Section 2.2 of the JTA, the following are unique mandates applicable to the Modeling and Simulation Domain.

M&S.2.2.2　　　　Mandates

M&S.2.2.2.1　　　　HLA Rules

HLA Rules: These rules comprise a set of underlying technical principles for the HLA. For federations, the rules address the requirement for a federation object model (FOM), object ownership and representation, and data exchange. For federates, the rules require a simulation object model (SOM), time management in accordance with the HLA Runtime Infrastructure (RTI) time management services, and certain restrictions on attribute ownership and updates.

- High Level Architecture Rules, Version 1.3, February 1998.

M&S.2.2.2.2　　　　HLA Interface Specification

HLA Interface Specification: HLA federates interact with an RTI (analogous to a special-purpose distributed operating system) to establish and maintain a federation and to support efficient information exchange among simulations and other federates. The HLA interface specification defines the nature of these interactions, which are arranged into sets of basic RTI services.

- High Level Architecture Interface Specification, Version 1.3, February 1998.

M&S.2.2.2.3　　　　HLA Object Model Template Specification

HLA Object Model Template: The HLA requires simulations (and other federates) and federations to each have an object model describing the entities represented in the simulations and the data to be exchanged across the federation. The HLA Object Model Template prescribes the method for recording the

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information in the object models, to include objects, attributes, interactions, and parameters, but it does not define the specific data (e.g., vehicles, unit types) that will appear in the object models.

- High Level Architecture Object Model Template, Version 1.3, February 1998.

M&S.2.3 INFORMATION TRANSFER STANDARDS

There are no additional Information Transfer Standards applicable to modeling and simulation beyond those specified in Section 2.3 of the JTA.

M&S.2.4 INFORMATION MODELING, METADATA, AND INFORMATION EXCHANGE STANDARDS

M&S.2.4.1 Introduction

In addition to those mandates for Information Modeling, Metadata, and Information Exchange Standards described in Section 2.4 of the JTA, the following mandates are applicable to the Modeling and Simulation Domain.

M&S.2.4.2 Mandates

M&S.2.4.2.1 Federation Execution Details Data Interchange Format (FED DIF)

This DIF is the input/output vehicle for sharing HLA initialization data. It contains data from the Federation Object Model as well as additional initialization data needed by the HLA Runtime Infrastructure (RTI) and other HLA initialization tools. The content of the FED DIF is compliant with the HLA Interface Specification referenced above.

- Federation Execution Details Data Interchange Format, Version 1.3, February 1998.

M&S.2.4.2.2 Object Model Template Data Interchange Format

A data interchange format has been adopted as an input/output vehicle for sharing HLA object models presented in the standard Object Model Template (OMT) among object model developers and users.

- Object Model Template Data Interchange Format (OMT DIF), Version 1.3, February 1998.

M&S.2.4.2.3 Standard Simulator Database Interchange Format (SIF)

A DoD data exchange standard (MIL-STD-1821) has been adopted as an input/output vehicle for sharing externally created visual terrain simulator databases among the operational system training and mission rehearsal communities.

- MIL-STD-1821, Standard Simulator Data Base (SSDB) Interchange Format (SIF) Design Standard, 17 June 1993, with Notice of Change 1, 17 April 1994, and Notice of Change 2, 17 February 1996.

M&S.2.4.3 Emerging Standards

M&S.2.4.3.1 Synthetic Environment Data Representation and Interchange Specification (SEDRIS)

No standard currently exists for comprehensively describing and interchanging environmental data in all domains (terrain, ocean, atmosphere, and space) among M&S applications supporting the broad range of acquisition, analysis, and training requirements. SIF will be replaced by SEDRIS. SEDRIS establishes a uniform and effective interchange specification for the pre-runtime distribution of source data and integrated databases. The specification encompasses a robust data model, data dictionary, and interchange

format supported by read and write application program interfaces (APIs), data viewers, a data model browser, and analytical verification and validation data model compliance tools. While designed to meet M&S community requirements, the interchange specification has the potential for also being used for natural environment data in DoD operational systems.

M&S.2.4.3.2 Object Model Data Dictionary

The Object Model Data Dictionary is being developed to support the development and reuse of Federation Object Models (FOMs) and Simulation Object Models (SOMs). This will greatly reduce the time needed to develop new HLA applications and transition legacy systems to the HLA. Initially, content standards are being developed based on the requirements of several programs, which are early adopters of the HLA standards. The early adopter programs cover a broad range of simulation applications from engineering to analysis and multiple levels of aggregation from platform-level (previously addressed by the IEEE 1278.1 Protocol Data Unit standards) to aggregate unit simulations (previously addressed by the Aggregate Level Simulation Protocol). The object model requirements of these programs are being consolidated into a common set of data elements, specifying both semantics and syntax. Where existing DoD standards do not exist, they will be developed through the HLA Object Model Data Dictionary process.

M&S.2.5 HUMAN-COMPUTER INTERFACE STANDARDS

There are no additional Human-Computer Interface standards applicable to modeling and simulation beyond those specified in Section 2.5 of the JTA.

M&S.2.6 INFORMATION SYSTEMS SECURITY STANDARDS

There are no additional Information Systems Security standards applicable to modeling and simulation beyond those specified in Section 2.6 of the JTA.

M&S.3 DOMAIN SPECIFIC SERVICE AREAS

There are no domain specific service areas for the Modeling and Simulation Domain.